

## Comparative Evaluation of Simultaneous Bone Marrow Aspiration and Bone Marrow Biopsy: An Institutional Experience

Pampa Ch Toi · Renu G'Boy Varghese · Ramji Rai

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**Abstract** Bone marrow aspirations and bone marrow biopsies are important diagnostic procedures. A comparative study of both the procedures done simultaneously was retrospectively reviewed in 160 cases where the clinical history is correlated with BMA and BMB results. The advantage of each method is analyzed. Correlation of our findings with that given in the literature is done to give a guideline for both techniques. We have found that 61.25% of the cases showed a positive correlation between bone marrow aspiration and bone marrow biopsy. However, we found that tuberculous granulomas and Hodgkin disease involvement of the marrow were detected better in bone marrow biopsies. The advantage of both the procedures done together provided more material and enabled us to study the cytomorphology of the cells, with the pattern of distribution of the cells depending on the cases. However, when both the procedures are done simultaneously, a proper technique is required so as to yield good diagnostic material.

**Keywords** Bone marrow aspirate · Bone marrow biopsy · Simultaneous · Comparative evaluation

### Introduction

Bone marrow aspirations and bone marrow biopsies are very useful diagnostic procedures for the diagnosis of

haematological and non-haematological malignancies, typing of anaemia, evaluation of pyrexia of unknown origin and infective diseases. These procedures are also valuable for follow up of patients undergoing chemotherapy, bone marrow transplantation and other forms of medical treatment [1, 2]. Involvement of marrow by metastatic tumour, have an effect on clinical treatment and prognosis. Similarly involvement of the marrow by granulomatous lesion especially tuberculous granulomas may be easily identified in bone marrow biopsies. Moreover in cases where malignancies are not clinically suspected, bone marrow aspirations and biopsies have been useful in detecting non-hematologic malignancies. When both the procedures are performed simultaneously, they are complementary to each other there is more material to study the morphology and the pattern of distribution of the cells [3]. This study was conducted in our institute to evaluate the complementary role of both the procedures done simultaneously and to see the advantages and disadvantages of these procedures.

### Materials and Methods

We retrospectively reviewed a total number of 257 bone marrow aspirate (BMA) and 192 bone marrow biopsies (BMB) examined in the department of pathology of our institution from Jan 2003 to Dec 2007.

A total of 160 cases where both BMA and BMB were done simultaneously were included in the study. BMA were stained with Leishman's stain, the BMB were stained with haematoxylin and eosin stain. Other special stains such as PAS, Reticulin and Perl's were also done on all cases.

P. C. Toi (✉) · R. G'BoyVarghese · R. Rai  
Department of Pathology, Pondicherry Institute of Medical Sciences, Kalapet, Pondicherry 605014, India  
e-mail: Pampa.toi@gmail.com

## Results

The total numbers of cases reviewed were 160 cases where BMA and BMB were done together. The results of the comparative evaluation was divided into

- (1) Number of cases that showed positive correlation between BMA and BMB
- (2) Diagnosis on BMB alone where BMA was not contributory to the diagnosis
- (3) Number of cases where diagnosis was given on BMA alone, BMB was non contributory
- (4) Number of cases where a definite opinion could not be given either in BMA or in BMB.

- (1) Out of the 160 cases studied there was a positive correlation in 98 cases (61.25%). Table 1 shows the spectrum of cases with a positive correlation in both BMA and BMB.
- (2) There were 20 cases (12.5%) where diagnosis was possible on BMB alone. BMA was non contributory (Table 2).
- (3) There was only a single case which was diagnosed as metastasis to the marrow by BMA. Here the BMB showed an infarcted marrow.
- (4) The cases where a definite opinion could not be given either in BMA or in BMB comprised 25.6% (41/160). The reports were varying from an inadequate BMA, where the BMB is hypercellular or

**Table 1** Positive correlation between bone marrow aspiration and bone marrow biopsy

Sl. No	Diagnosis	No. of cases
1	Reactive marrow	37
2	Erythroid hyperplasia	22
3	Granulomatous reaction Suggestive of TB	02
4	Malaria	01
5	HIV (Features are consistent with marrow changes in HIV patients)	03
6	Storage disorder (Gaucher's disease)	01
7	Aplastic anaemia	01
8	ITP (Immune thrombocytopenia purpura)	02
9	Hypocellular marrow	06
10	Multiple myeloma	08
11	Leukaemia	05 (AML-4, 1CLL/SLL)
12	Essential thrombocythemia	02
13	Metastasis	03
14	MDS	01
15	Within normal limits	04

**Table 2** Diagnosis on bone marrow biopsy alone

Sl. No	Diagnosis	No. of cases
1	Tuberculous granulomas	08
2	Hodgkin's disease	03
3	Metastasis	02
4	Multiple myeloma	01
5	Leukaemia	03 (2AML, 1CLL/SLL)
6	Chronic myeloproliferative disorder	01
7	Pagets disease	01
8	ITP	01

reactive, in some cases BMA appeared to be normal, but with no marrow spaces in the BMB.

In our study we found the highest correlation rate with the diagnosis given as reactive marrow (37.7%) and cases diagnosed as erythroid hyperplasia. In those cases where a diagnosis of erythroid hyperplasia (18.8%) were given, depending on whether macronormoblastic or micronormoblastic, they were further worked up, mostly for anaemia, and accordingly Perls stains for iron was studied, biochemical parameters were taken into consideration and the impression was given. There was one case of megaloblastic anaemia where both BMA and BMB were available. There was no problem of identifying the megaloblast in BMA, but in BMB, megaloblast looked like a leukaemic blast which is a known fact.

Other cases with a good positive correlation were hematological malignancies such as multiple myeloma where there was (88.8%) correlation. Out of a total of 9 cases diagnosed, 8 cases showed a positive correlation in both BMA and BMB. Leukaemias showed a positive correlation in 62.5% cases (5/8), those cases diagnosed by BMB alone showed a hypocellular BMA. Essential thrombocythemia showed 100% correlation (2/2). Amongst the non hematological malignancies metastatic to the bone marrow, 50% cases (3/6) showed positive correlation in both BMA and BMB, two of the cases were clinically not suspected for non hematologic malignancies. One case was clinically suspected to be a multiple myeloma. The primary tumour could not be ascertained as the patient died before further investigations could be done. The other case was investigated for anaemia. Here the primary malignancy was found in the breast.

## Discussion

BMA and BMB are important diagnostic procedures for diagnosis of hematological, non hematological

malignancies and other diseases. These procedures are also valuable for follow up of patients undergoing chemotherapy, bone marrow transplantation and other forms of medical treatment [1, 2]. It is a well known fact that bone marrow aspiration and bone marrow biopsy complement each other. Nowadays both specimens are routinely obtained at the same time and usually same site [2]. In our study, we did a comparative evaluation of all such BMA and BMB, to see the complementary role of both the procedures, to study the advantages and disadvantages of both the procedures done simultaneously.

There was 61.25% positive correlation between BMA and BMB in our study. Those cases diagnosed as reactive marrow and those with erythroid hyperplasia showed the highest positive correlation. Those cases which were clinically sent for evaluation of anaemia showing erythroid hyperplasia with either macronormoblastic or micronormoblastic proliferation were further worked up. Perl's stain was done and the biochemical parameters were taken into consideration. The diagnosis was given either as iron deficiency anaemia or megaloblastic anaemia. We had one case of megaloblastic anaemia where both BMA and BMB were available. Generally BMA usually is performed alone in cases clinically suspected as megaloblastic anaemia. As this case presented with pancytopenia both the procedures were done simultaneously. The BMA showed the typical megaloblasts whereas the BMB showed multiple blast which could have been mistaken for leukaemia [4]. Though BMB examination is actually not useful for diagnosis of megaloblastic anaemia [4], the BMA was helpful in giving the correct diagnosis.

88.8% (8/9) of multiple myeloma showed a positive correlation in BMA and BMB. Though it was not difficult to diagnose multiple myeloma in BMA alone, where the aspirate was good, there were cases where the plasma cells were scattered. In such cases BMB complemented the BMA, as it helps to identify compact masses of plasma cells with no stroma as observed by Sabarhwal et al. [3]. Our study correlated with the study done by Charles et al. [5] where they detected myeloma in trephine biopsies and all simultaneous bone marrow aspirates.

50% cases (3/6) of non hematologic malignancies metastasis showed a positive correlation between BMA and BMB. 33% cases (2/6) were diagnosed on BMB alone, BMA in these cases showed reactive marrow. There was a single case of metastasis which was diagnosed by BMA where the BMB showed an infarcted marrow. Occasionally tumour deposits may be necrotic on core biopsy which is in agreement with observation by Cotelingam et al. [6]. Many studies done previously showed that BMB was a better procedure for detecting metastatic tumour. [7–9], Only 50% cases showed a positive correlation in our study, which is in agreement with studies by Atac et al. [10]

where he studied 39 cases and each positive BMB was also positive by BMA. In our study the metastasis were mostly adenocarcinomas 3/6 (primary from gastric carcinoma), 1/6 small cell carcinoma where the primary was unidentified, 2/6 cases of poorly differentiated carcinoma. (1 from breast carcinoma, 1 unknown). We found that both BMB and BMA are good diagnostic procedures for clinically unsuspected non hematologic malignancies because two of our cases were clinically unsuspected to have malignancy. One case diagnosed as poorly differentiated carcinoma was found to have a very tiny breast lump which turned out to be an infiltrating duct carcinoma. The other case was clinically suspected as multiple myeloma. The primary could not be established as the patient died. We felt that BMA and BMB are still very useful tools in diagnosis of unsuspected non haematological malignancies, where patients present with different clinical features. We are in close agreement with the study by Ozkalemkas et al. [11] who studied 19 cases of unsuspected non hematologic malignancy in BMA and BMB and found it useful as a short cut in evaluation of such cases.

In our study we diagnosed all cases (3/3) of Hodgkin's disease by BMB alone. One patient was clinically suspected to have tuberculosis, but BMB showed features of Hodgkin's disease., BMA showed reactive marrow. Our findings correlated with those of Moid et al. [7] where they reported 95% of diagnosis of Hodgkin's disease by BMB alone. Our findings is also in close agreement with that of Howell et al. [12] whose study suggest that BMA does not have a significant role in detecting marrow involvement by Hodgkin's disease. Similar findings were reported by Sharma et al. [13] where they diagnosed Hodgkin's disease in BMB alone.

We found that 80% cases (8/10) of granulomatous lesion in the bone marrow were diagnosed by BMB alone. Most of these cases were those of tuberculous granuloma. Granulomatous change may be specific or non specific. [8, 14] Though AFB stain was not positive in all the cases, the previous clinical history, presentation and other investigations helped us to clinch the diagnosis of a tuberculous granuloma. BMB is a better procedure for detecting granulomas in the marrow.

Though these two procedures are routinely used, the technique employed plays a very important role. In cases where Hodgkin's disease is suspected, or tuberculosis is suspected, a bone marrow biopsy alone with a good imprint smear will suffice.

Special emphasis in this study was also given to those cases where a definite opinion could not be given either in BMA and BMB comprising 25.6% of the cases (41/160). As we have mentioned in our study, the problem was either the BMA or BMB is inadequate, diluted. BMA appeared normal in some cases, whereas BMB showed either a

hypercellular or hypocellular marrow. Though the advantages of both the procedures done simultaneously far outweighs the disadvantages, BMA and BMB are painful procedures, and keeping the patients in mind, our aim should be to get a good sample. We have observed that in some cases where aspiration was done prior to core biopsy, cellular aspirates showed hypocellular picture on BMB perhaps due to the BMB being done from the same area. When both the procedures are done at the same time it is preferable to use the two needle technique, change the position of the needle after one procedure to an adjacent site in order to get maximum material.

We also felt that whenever a BMB is done, an imprint smear should be made simultaneously to get the correct morphology of the cells in that area, if the aspirate is not good. We have recently started making an imprint smear routinely for every BMB and we feel that it is very useful to study the morphology of the cells. In our institution the two needle technique of doing BMA and BMB is being followed, and we are in close agreement with Islam's observation that the two needle technique has definite advantages [2]. By following this method, both procedures can be done simultaneously, which may yield good material for diagnosis.

## Conclusion

BMA & BMB are diagnostic procedure used routinely nowadays. Both the procedures are complementary to each other. In our experience we felt that for diagnostic purpose both the procedures can be done simultaneously as BMA gives better morphology of the cells and BMB gives a good picture regarding the pattern of distribution of cells. We found that BMB was especially useful in diagnosis of Hodgkin's disease, tuberculous granulomas and metastasis of non hematological malignancies. We also found these procedures quite useful in cases where malignancies was not suspected, BMA and BMB are very useful and still an important diagnostic tool. While performing the BMA and BMB simultaneously, employment of proper technique should be kept in mind so as to yield the maximum

material and reduce discomfort to the patient by not repeating the procedure due to inadequate material.

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